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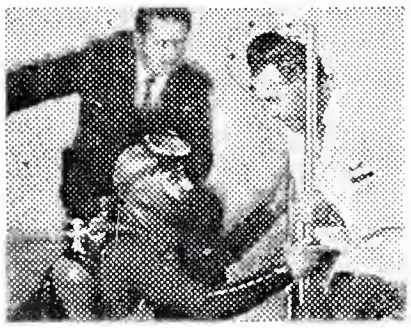

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Guest Editorial

DR. JAMES K. Y. YAO was born in Fukien, China. He graduated with his M.D. (cum laude) from the University of the Philippines, College of Medicine (Gold Medal) and received a B.Sc. Med. from the University of Toronto. Dr. Yao did his postgraduate training in Toronto and Bristol. He has lectured in the Department of Surgery, University of Toronto and is now Staff Surgeon in the Division of Cardiovascular Surgery, St. Michael's Hospital. In addition he is a Fellow of the Royal College of Surgeons of Canada, Fellow of the American College of Surgeons and Fellow of the American College of Chest Physicians.

Overseas Surgery

Quite frequently in the news one reads of this or that medical team undertaking a pilgrimage to the third world. A couple of years ago our cardiovascular team from St. Michael's Hospital received an invitation from Dr. T. Bangayan, Chief of Cardiology of the Chinese General Hospital, one of the teaching hospitals of the University of the Philippines. It did not take long to pack our* bags and our instruments and off we went to Malton and thence to Manila. Upon arrival, we were surprised to be treated in the manner of dignitaries with full television, radio and press coverage and meeting with the highest echelons (including the President and his lady). We lectured to medical groups, we wined and dined and we operated. We operated upon fourteen patients in all, procedures ranging from simple closure of atrial septal defects to total correction of Tetralogy of Fallot. All our patients survived and we have received no delayed adverse reports two years later.

More recently we** were invited to Trinidad and Tobago and again had a tremendous reception. Here we had a twofold mission, to do some surgery and also help set up an intensive care unit. We did not lose a patient although we did try to correct a "coarctation of the aorta" which proved to be an atherosclerotic narrowing, an understandable error in view of the lack of sophisticated diagnostic equipment. The local clinicians had a well developed acumen in making diagnoses on the basis of simple physical findings. Still this was insufficient to exclude a rare (to Canadians) localized atheromatous lesion in the aorta in a young patient in his twenties. Angiography would have, of course, shortcircuited this operation.

No one expected first rate facilities and we did not find any. In the Philippines there was a catheterization laboratory without cineangiography. There was a pump oxygenator without a pump technician (we had ours along). There were two cardiac surgeons trained in the United States who had not operated for some years, and an anaesthetist without open heart experience. The recovery room had only four beds and since we did two to three cases a day, we had to take an unscheduled middle of of the week holiday in Hong Kong to allow the Intensive Care Unit to clear.

In Trinidad there was no catheterization laboratory at all nor any angiographic facilities. The operating room facilities were limited in instruments, lighting and anaesthetic equipment. There were fly swatters in the operating room although their potential victims were not in sight. There was no recovery room facility whatsoever and the intensive care unit we were to help set up would have been better constructed first.

GUEST EDITORIAL

It was an intense experience in the Philippines and in Trinidad. We worked hard, we were entertained sumptuously and the attention was pleasingly embarrassing. We cured a handful of patients who might have remained ill without our visit. We have collected and made a lot of good impressions. We made Canada a slightly firmer shade of gray in the eyes of the local population. Yet there remained a nagging doubt whether we were really doing the best thing for our hosts. Is this what they really need, a virtuoso performance on a handful of patients? Would these patients not have been more safely and more economically handled at an established medical centre? Medicine in these countries is not on a par with ours. It is barely walking and we are teaching it acrobatics. The Canadian International Development Agency, CARE Canada, churches, private charitable organizations, individual sponsors and even airlines contributed to make our trips and other trips of similar nature possible. I wonder whether such contributions might not be better spent in elevating the general health care for the largest group of sick in these countries, undertaking measures to lower maternal and infant mortality, eradicating nutritional deficiency and infectious diseases. Rural health clinics are necessities of life in these countries in view of the fact that millions of persons live and die without ever seeing a physician. In view of this, is not cardiovascular surgery (and in fact, most forms of specialized surgery) a luxury they cannot afford in the foreseeable future?

Paralleling these forays of medical teams to underdeveloped areas are our training programs for physicians from those countries. These highly trained people often return to their homelands only to do appendectomies. Soon they may return to Canada or to the U.S.A. in frustration at not being able to do work commensurate with their laboriously acquired skill.

We should therefore, very clearly keep in focus exactly what we are doing on our medical missions to far off lands. Mainly and by far we are public relations officers for Canada and hopefully we are not flaunting our wealth in the face of the tender egos of our host populace. We provide a stimulus and a sting of excitement for the local profession, pointing to a level towards which to aim, if the opportunity were to arise in the near future. We eradicate some of our own complacencies and gain appreciation for the standard of medical care that we jadedly accept.

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* Other team members: Drs. D. C. Finlayson, I. Echevarre and Miss Anne Wetherall.
** Other team members: Drs. L. Casella, W. Young, J. Peacock, P. Kamat and Miss Pauline Kattela.

Editorial

This issue marks the completion of Volume LI of the U of T Medical Journal.

I owe a special vote of thanks to this year's associate editors who did a fine job in compiling their issues with the minimum delay.

I am also indebted to the assistant editors whose diligence saved me many hours of work. John Le Nobel did a fine job as finance manager and Hannah Zuckerman very capably kept our subscriptions and circulation business in order.

I would like to thank the people of Maple Leaf Press especially Konrad Godzinski for his unfailing enthusiasm in looking after the Journal's production.

We are especially grateful to the Medical Alumni Association of the University of Toronto for their generous contribution of money, their support and their interest.

Finally we are indebted to the authors and contributors to this year's Journal.

The continued success of the University of Toronto Medical Journal hinges on the zeal and enthusiasm of such people as are willing to contribute their time and effort to this publication. Contributing to the Medical Journal can be fun; it can help you study a particular topic; it will help develop your writing skills, your ability to communicate with your colleagues. I urge you to consider this an important part of your medical education.

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Fractures of the Calcaneus (Os Calcis) *

Roman J. Dykun, 7T5

INTRODUCTION

One of the constant and ever-present features of man's existence on earth has been fractures of that lowly bone, the calcaneus. It has been a common injury since man began to climb trees, to work from heights or to escape through a second storey window upon hearing the footsteps of the approaching husband. The latter mechanism of injury led to the designation "lovers heels".

A fracture of the calcaneus occurs when a vertical force is exerted through the foot and the talus compresses the calcaneus against a hard surface. This compressive force on the calcaneus can occur from above, for example when a man falls from a height and lands on his feet or, less frequently, the force can occur from below as, when a sailor on deck suffers the effects of underwater explosion.

The fractures which result can be classified under two general groups, those that involve the subtalar joint and those that do not. Fractures which do not involve the subtalar joint, about 25% of the total group, are easily treated and complete recovery is to be expected. However, for those remaining 75% of calcaneal fractures which do involve the subtalar joint, there is no standard treatment, since most modes of therapy have produced only poor results. This article is devoted to the perplexing problem of calcaneal fractures with subtalar joint involvement.

HISTORICAL BACKGROUND

Bandaging and elevation of the foot seems to have been the treatment of choice from the time of Hippocrates until the mid nineteenth century. At that time, Clark[1] introduced a traction device which kept the foot in plantar flexion, thereby reducing the stress force of the tendo-Achillis on the calcaneus. Clark believed that this arrangement hastened the healing of the fracture. Open reduction of the calcaneus made its debut in 1882[2]. Unfortunately, either traction or open reduction were often unsuccessful in reducing the fragmented calcaneus to its anatomical position.

In 1931, Bohler[3] advocated traction with pin fixation, and a heel clamp to minimize lateral spreading of the heel. A plaster cast was then applied from the toes to below the knee, moulded around the malleoli and over the sides of the calcaneus and kept in this position for about ten weeks. This method of treatment has long since been abandoned because the clamp proved to be ineffective, and furthermore, caused shin problems. However, because of his early interest in the subject of os calcis fractures, Bohler's name has been applied to the tuber joint angle whose correction, he maintained, should be the basis of therapy. Since all methods of treatment had poor results, most of the initial operative procedures practiced in North America were devoted to the concept of arthrodesis, either of the subtalar joint alone or in conjunction with other tarsal joints. The classic description of the subtalar fusion by a posterior approach was published by Gallie[4] in 1943; and an excellent series of cases utilizing this method were analyzed separately by R. I. Harris[5] in 1946, Geckeler[6] in 1950 and Dick[7] in 1953.

A radical concept, presented by Pridie[8] in 1947, was the complete excision of the calcaneus as treatment for comminuted fractures of this bone. It is fair to say few Orthopaedic surgeons share Pridies's point of view.

Today, in Canada, most Orthopaedic surgeons perform one of the following: subtalar arthrodesis, early active motion without reduction[9], open reduction of the calcaneus from the lateral approach[10] and, recently, open reduction from the medial side[11].

GENERAL PRESENTATION OF PATIENT

The history of a vertical drop from a height should suggest a calcaneal fracture. The patient usually presents with swelling and bruising around his heel accompanied by an acute crippling pain in the hind foot and around the malleoli. He can rarely walk on the affected foot. The heel is broadened and the vertical height is reduced. There is an "effusion of blood spreading towards the sole of the foot which never occurs in malleolus fractures"[12]. Perhaps most important of all, the major tenderness is limited to the area of the calcaneus.

Unfortunately, doctors still misinterpret this obvious clinical picture and fractures of the calcaneus can be overlooked. Bohler, in evaluating his own experience and the literature, states that "they are often regarded as fractures of the malleoli or as sprains of the ankle and then are treated for months by hot air, massage, passive movements and exercises with the Zander machine".

Since many calcaneal fractures occur after a fall from a height, fractures of the vertebral bodies may also occur. Schofield (1936)[18] reported a 12% incidence and Herman (1937) a 10% incidence of os calcis fractures associated with anterior wedge fractures of the vertebrae. The lesions occur most commonly at T_{12}, L_1, L_2 or L_3 levels. An examination for vertebral fractures should be routine on all patients with os calcis fractures.

PATHOGENESIS AND CLINICAL COURSE

An excellent and exhaustive survey of three hundred and ninety patients with fractures of the os calcis was performed by W. R. Lindsay and F. P. Dewar[9]. In their ten year follow-up they were able to identify three stages in the evolution of the disability due to

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** This article has been selected as the best article related to Orthopeadic Surgery in Vol. LI of the Journal. The author, Roman J. Dykun, 7T5, will receive the R. I. HARRIS Prize from the Division of Orthopeadic Surgery, University of Toronto.*

fractures of the os calcis. In the acute stage of injury, there was tremendous oedema and marked ecchymosis of the foot which slowly subsided. This is certainly indicative of soft tissue injury and Day[15] attributes some of the later persistent pain to scarring in the torn tissues at this stage. In almost all cases there was improvement in the degree of pain, until the patient finally experienced either no pain or only certain circumscribed areas of pain.

In the intermediate stage of the injury, improvement tended to stop after a few months and the pain remained constant. The late stage of injury was one of slow, continued improvement in the foot, and the patients cited activities that could not be well tolerated several years previously. The studies by Olovson and Mercer[16] are in full agreement with this concept of late, slow improvement.

Sir Reginald Watson-Jones[13] indicated that there were two main sources of physical disability from fractures of the calcaneus. The first was a thickening of the heel, resulting from the vertical crushing and a lateral spreading with separation of the antero-medial and postero-lateral pieces. Secondly, the upward displacement of the calcaneal tuberosity, which occurred in fractures involving the subtalar joint, amounted to shortening of the Achilles tendon. Indirectly this causes loss of power of the calf muscles and explains the patient's difficulty in standing on tiptoe and walking with a normal spring.

The separation of the calcaneal fracture fragments and the upward displacement of the subtalar joint can also lead to the formation of flat feet, since the longitudinal arch of the foot is destroyed. The normal arch of the hindfoot is reduced, eliminated or reversed. Essex-Lopresti[19] reported the case of a twenty-three year old serviceman with rigid painful flatfoot, a "tragedy of failure in treatment" which left him "condemned to two sticks and a sedentary life."

When the large postero-lateral fragment of the body of the calcaneus is displaced outwards, a valgus deformity results. This deformity combined with injury to the subtalar joint leads eventually to traumatic arthritis. But the commonest site for pain and the one which leads to the greatest amount of disability, according to Lindsay and Dewar, is localized below the lateral malleolus. This pain is not typical of joint pain and is not relieved by either fibrous or surgical arthrodesis.

Since the space between the os calcis and lateral malleolus is encroached upon by the lateral shift of the fracture fragments, the peroneal tendons and their sheaths can be trapped and a chronic stenosing tenosynovitis may result. Despite maintenance of the normal varus position of the medial calcaneal tuberosity, the forefoot is pulled into a valgus deformity by peroneal spasm. This syndrome, characterized by pain on motion and tenderness localized to the peroneal tendons behind and below the fibular malleolus, is another method whereby fracture of the os calcis can produce painful flatfoot[17].

X-RAY EXAMINATION OF CALCANEAL FRACTURES

For the purposes of treatment it is necessary to recognize the exact nature of the fracture of the os calcis, and this is only possible with the use of x-rays. At least two views are necessary; a lateral projection of the injured foot and a plantar dorsal projection to give an axial view of the os calcis. The latter view is obtained by placing the back of the foot on the x-ray cassette, the ankle being dorsiflexed by means of a bandage held by the patient. The axis of the x-ray tube is directed at an angle of 45 degrees on to the plantar surface. A profile of the body of the calcaneus with its lateral and medial surfaces, the sustenaculum tali and the subtalar joint can be seen. (Fig. 1, Fig. 2) For added visualization of the subtalar joint, an oblique projection[14] may be performed.

Fig. 1 – Lateral projection of left foot.

Examine the x-ray of the subtalar joint. There is normally an angle on the dorsum of the calcaneus between the axis of the tuberosity and the body of the bone which is known as "Bohlers angle" or the "tuberosity joint angle". If two lines are drawn along the upper aspect of the calcaneus, one from the highest central point to the anterior lip and the other from the highest central point to the upper part of the tuberosity (Bohler, 1935), these two lines will normally make an angle of 28 to 40 degrees with each other. This is "Bohler's angle". (Fig. 3)

Obviously, if there is a compression of the calcaneus in the region of the talocalcaneal joint, this angle will be reduced, obliterated completely or even become negative. Similarly, a fracture which raises the tuber-

osity upwards will diminish the tuber-joint angle. This latter situation also has the net effect of displacing the insertion of Achilles tendon upwards, producing a functional lengthening and making it difficult to stand on tiptoe or to walk with a normal spring.

Fig. 2 – Plantar Dorsal projection of left foot.

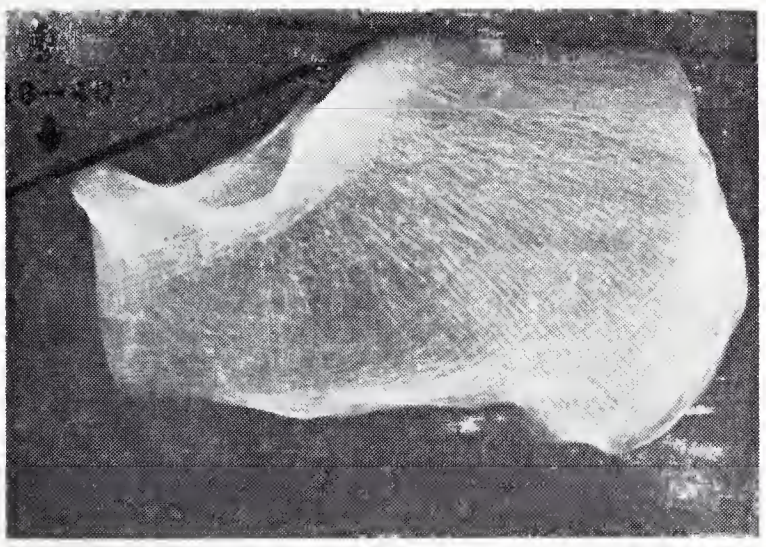


Fig. 3 – Bohler's angle.

MECHANISM OF FRACTURE AND THE X-RAY INTERPRETATION

With a knowledge of both the x-ray appearance and the mechanism of the injury we can better understand the character of the bony and soft tissue trauma. Let us turn our attention, therefore to the mechanism of the fracture[13, 19, 20].

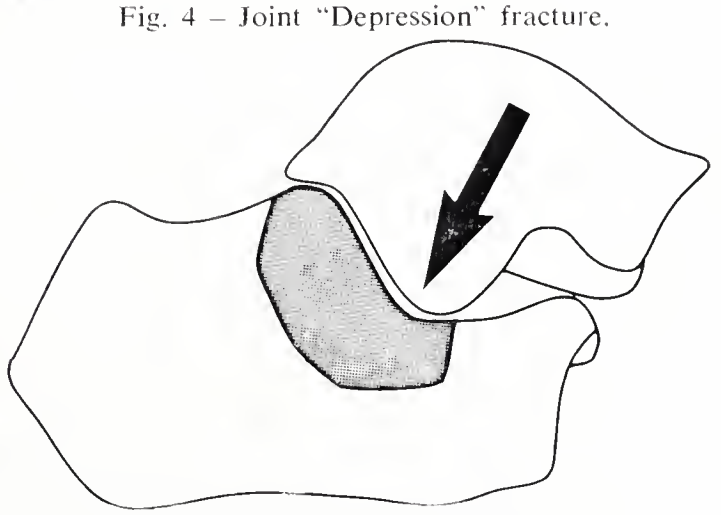
The patient drops from a height and lands heavily on his feet. The momentum of his body is carried along the tibia and transmitted through the talus to the calcaneus by two routes which we can call the outer route and the inner route. On the lateral side of the os calcis, the posterior subtalar joint is forcefully everted and the sharp spur of the talus is driven like an axe into the calcaneus, shattering the lateral cortex. This is the "outer route" of force transmission and with minor forces this may be the full extent of the injury.

The remainder of the force descends through the anterior subtalar joint, "the inner route", shearing off the sustenaculum tali together with the medial third of the posterior subtalar joint surface. This fracture pattern is remarkably constant. If the force continues, further displacement will occur producing a vertical fracture with subtalar joint depression and a loss of Bohler's angle.

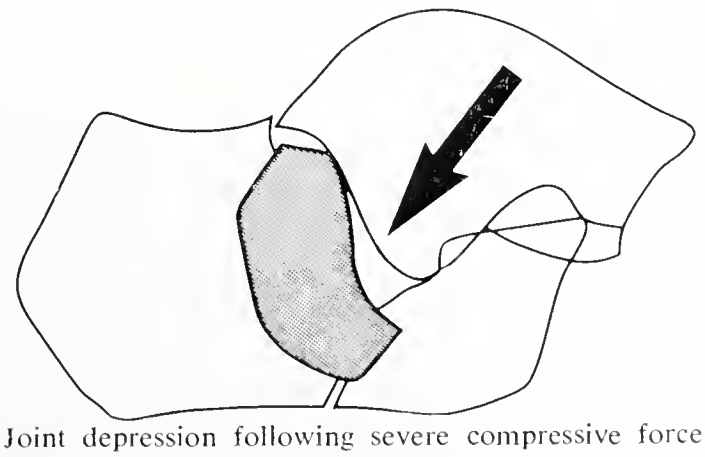
The vertical fracture is a secondary fracture line in the calcaneal body, just behind the posterior subtalar joint. With moderate or severe force, a fragment containing the lateral two-thirds of the subtalar joint is displaced into the cancellous bone of the body of the calcaneus immediately inside the lateral cortex. The lateral cortex, already split along the outer route, is driven further laterally, producing the typical broadening of the bone. It is this lateral fragment that is probably responsible for the late lateral malleolar pain.

The vertical fracture line may extend to the upper aspect of the tuberosity, separating the posterior subtalar joint from the rest of the bone or it may turn horizontally and exit through the back of the tuberosity leaving the superior cortex intact. This variation in the secondary fracture produces either the "depression" or "tongue" type fractures described by Essex-Lopresti. (Fig. 4)

Fig. 4 – Joint "Depression" fracture.



A. Fissuing after minimal fracturing force.



B. Joint depression following severe compressive force.

RECENT DEVELOPMENTS IN THE STUDY OF CALCANEAL FRACTURES

Studies have suggested treating os calcis fractures with subtalar involvement by a variety of techniques [4, 9, 11, 16], but most agree that regardless of the method used, the patient often develops late painful complications. To investigate this point, I have begun a review of the various techniques used at the Toronto General Hospital between 1968 and 1972 in the treatment of calcaneal fractures with subtalar joint involvement. These are summarized in Table 1.

TABLE 1

Review of treatment for fractures of the calcaneus at the Toronto General Hospital 1968-1972.

A. Total number of fractures of the calcaneus:	81
1. Number of calcaneal fractures with subtalar involvement:	56
2. Number of calcaneal fractures without subtalar involvement:	25
B. Methods of treatment for fractures with subtalar joint involvement:	
1. Immediate subtalar fusion:	20
2. Conservative therapy:	
a) Jones bandage:	14
b) Cast:	13
3. Open reduction:	
a) using the lateral approach:	4
b) using the Steinmann pin:	4
4. Percutaneous manipulation:	1
Total:	56

For the purpose of our review only thirty-three patients had sufficient follow-up recorded in the hospital charts. (Table 2)

TABLE 2

1. Immediate subtalar fusion:	4
2. Conservative therapy:	
a) Jones bandage:	13
b) Cast:	7
3. Open reduction:	
a) using the lateral approach:	4
b) using the Steinmann pin:	4
4. Percutaneous manipulation:	1
Total:	33

Of the thirty-three patients reviewed a total of nineteen had serious complaints following treatment.

In the group of patients treated by immediate subtalar fusion three of the four complained of painful heels.

In the group of patients treated by Jones bandage, five had painful heels, one had pain around the lateral malleolus with subtalar arthritis, one had limited dorsiflexion of the foot, one had subtalar arthritis and a short heel and one had subtalar arthritis and peroneal spasm. Thus, nine of the thirteen patients had serious complaints.

Severe complaints were found in four of the seven patients treated by casts. One had a painful heel and pain around the lateral malleolus, one had a painful heel with a valgus deformity of the foot, one had pain around the lateral malleolus and one had lateral malleolar pain with a valgus deformity of the foot and spreading of the heel.

Of the patients treated by open reduction using the lateral approach one had a painful heel with spreading of the heel, one had a painful heel with limited dorsiflexion of the foot and one had pain around the lateral malleolus. Therefore, three of the four patients in this group had significant complaints.

There were no complaints among the patients treated by open reduction using the Steinmann pin and percutaneous manipulation. However, it is possible that subtalar involvement was only minimal in these two groups of patients.

OBSERVATIONS

1. Painful heels, pain around the lateral malleoli and arthritis involving the subtalar joint are the most common complaints. This is in agreement with other studies[3, 13].

2. It is noted that the most common form of treatment has been conservative therapy. However, from the above statistics it appears this mode of therapy has caused proportionately more disabilities than the use of open reduction. In fact, in this survey, two patients who were treated by conservative therapy developed such extreme heel pain that a Symes amputation was performed.

If the current results are poor, are there any better methods now available? Recently it has been reported that open reduction of the calcaneus from the medial aspect products promising results (McReynolds, 1972). A study has been started to compare the postoperative results of this technique with the other methods commonly practiced. The initial results of this study have been encouraging – open reduction from the medial aspect may well be the solution to the perplexing problem of calcaneal fractures with subtalar joint involvement.

SUMMARY

The importance of distinguishing calcaneal fractures with subtalar joint involvement from those with no involvement has been emphasized. Special emphasis is placed on the characteristic clinical features of os calcis fractures together with their x-ray appearance and it is demonstrated that the mechanism of injury can well be correlated with the physical findings. The past history and the current status of treatment of os calcis fractures with subtalar joint involvement are described.

ACKNOWLEDGEMENTS

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Undergraduate bursaries	4,000.00
Transportation fund for Medical student electives (The maximum individual grant is $100. Applications for 1974-75 electives are being accepted up to April 12, 1974 for the period June 3, 1974 - November 17, 1974; and up to October 1, 1974 for the period November 18, 1974 - May 4, 1975)	4,000.00
Medical Student Summer Fellowships (19 Fellowships at $1,200)	22,800.00
Graduate bursaries	900.00
Fund for Educational Activities	200.00

The Student Aid Committee also has responsibility for three loan funds.

The Medical Alumni Association Undergraduate Loan Fund — The main purpose of this fund is to provide short term, interest free loans to Medical students who require financial assistance during periods of temporary difficulty.

Robert Elgin Towle Loan Fund — This is an endowed loan fund which can provide interest free loan assistance to female undergraduates.

The Medical Alumni Association Graduate Loan Fund (including the Emma Bissell and Agnes E. Hamshaw Funds) — The purpose of this Fund is to provide interest free loans of up to $1,500 per year to physicians taking postgraduate training.

Further information about any of the above and application forms, if necessary, can be obtained from Mrs. N. S. Shenstone, Secretary, Medical Alumni Association.

Neck Masses: A Clinical Approach

Izzie Boxen, B.Sc., 7T4

INTRODUCTION

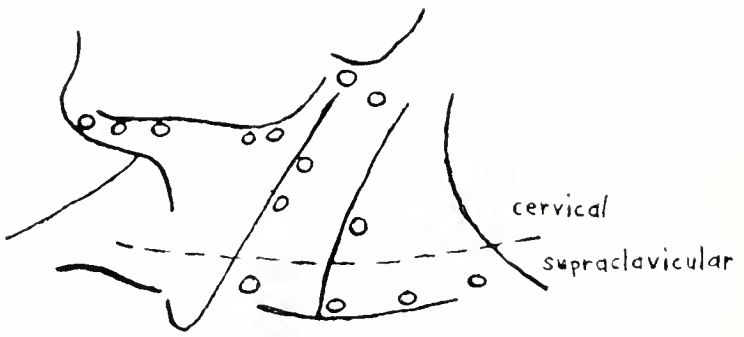
Lectures to University of Toronto medical students are given customarily on a systems basis – the cardiovascular system, the nervous system, endocrinology, etc. All too often, however, a patient presents with a complaint that is not amenable to systems thinking until at least a provisional diagnosis is made. Neck masses fall into this category, and a regional approach is most satisfactory.

When a patient first presents, a differential diagnosis listing the possible types of pathology involved can be sensibly formulated only after the anatomical identity of the lesion is established. To accomplish this, the approach must be systematic and thorough.

This article is therefore written on an anatomical basis, with the emphasis on common lesions and, especially, on malignancies.

LYMPH NODES

Lymph nodes in the neck follow a Z-shaped distribution on each side. Palpation of these should follow the distribution starting with the submental nodes and ending with the supraclavicular nodes. Palpation of both sides of the neck should be done simultaneously for comparison.

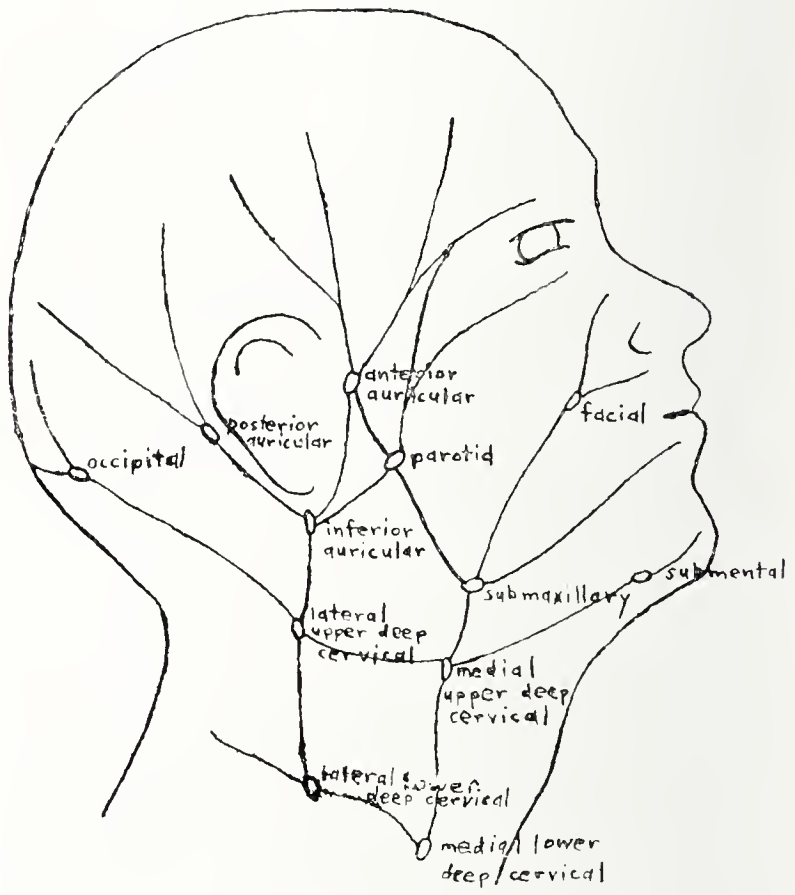


There are several structures in the neck which can be mistaken for nodes. These consist of the transverse process of the atlas, greater horns of the hyoid bone, thyroid cartilage, tracheal rings and calcified carotid bulbs. Occasionally a high-lying innominate artery can be felt between the sternomastoids in the base of the neck.

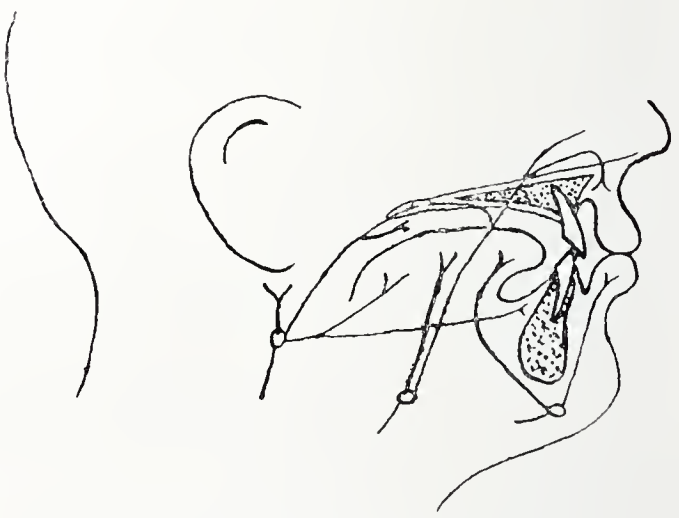
Nodes are most easily felt by rolling them under the pulp of a finger. By having the patient slightly shrug his sholders nodes deep to the clavicles can sometimes be felt. It is important to check for these when assessing lymphatic involvement in carcinomas of the head and neck.

As well as the geographic location of nodes the lymph drainage must be known in order to trace down an infection or a primary carcinoma.

It is best to remember the drainage channels in groups, for example: the occipital, posterior auricular and anterior auricular nodes drain the scalp, the anterior auricular and parotid nodes drain the upper and lower eyelids respectively, and the nasopharynx drains via the inferior auricular nodes and the longitudinal chain springing from them.



Lymphatic drainage of head and neck with names of regional nodes. (Modified, after Shafer, Hine and Levy[1].)



Lymphatic drainage of oral structures.

The age of the patient is also considered when assessing enlarged neck nodes. It is little wonder that these are usually due to infection of the upper respiratory tract in children since they have frequent infections and lymph nodes are a main line of defense. However, in the adult immunoglobulins normally provide a large part of the defense and enlarged nodes become a matter of concern since they are often due to malignancy.

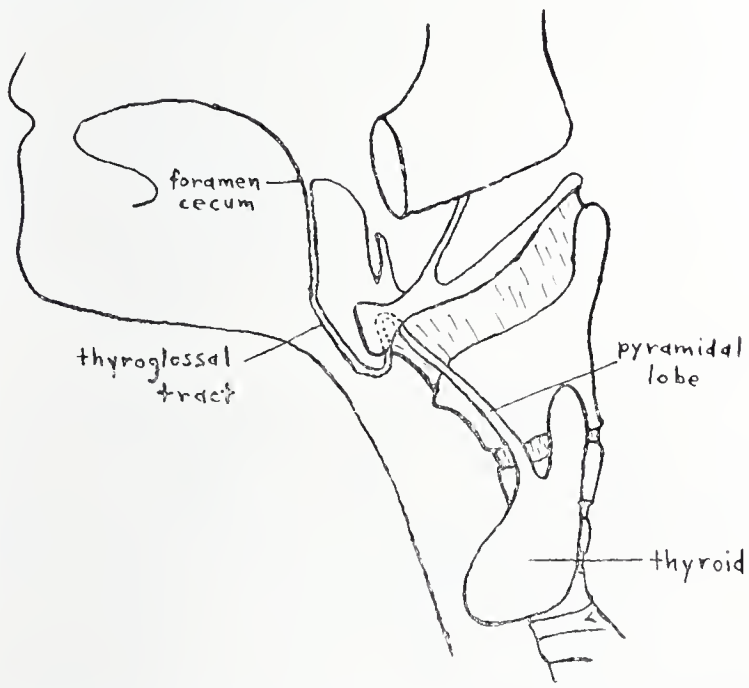
As elsewhere, malignancy is indicated by hard, irregular consistency, adherence to surrounding tissue and enlarged lymph nodes draining the area involved. Primary node tumours, or lymphomas, are softer than metastases in general. Bilateral involvement without the above features rules out malignancy.

Usually, metastases in the cervical and higher nodes comes from a head and neck primary and metastases in the supraclavicular area come from the lungs or G.I. tract[2].

Once a node is suspected of being abnormal it remains to decide whether it is due to infection or tumor. Biopsy must not be considered too hastily, however. The reasons for this will be discussed later. Biopsy is done only after adequate examination of the patient has failed to come up with a diagnosis. Except in the case of obvious malignancy, excised lymph nodes should be submitted for bacterial, T.B. and fungal culture as well as histology.

THYROID

The thyroid gland descends into the neck along the embryonic thyroglossal tract. Failure of the tract to become obliterated after thyroid descent can result in a thyroglossal duct cyst which presents as a soft cystic mass along the midline of the neck, but may be to one side. This is most often seen in young persons but can occur at any age, often after an upper respiratory infection.



Descent of thyroid gland. (Modified after E. J. Brintnall, J. Davies, W. C. Huffman and D. M. Lierle, Arch. Otolaryngol, *59*, 282, 1954).

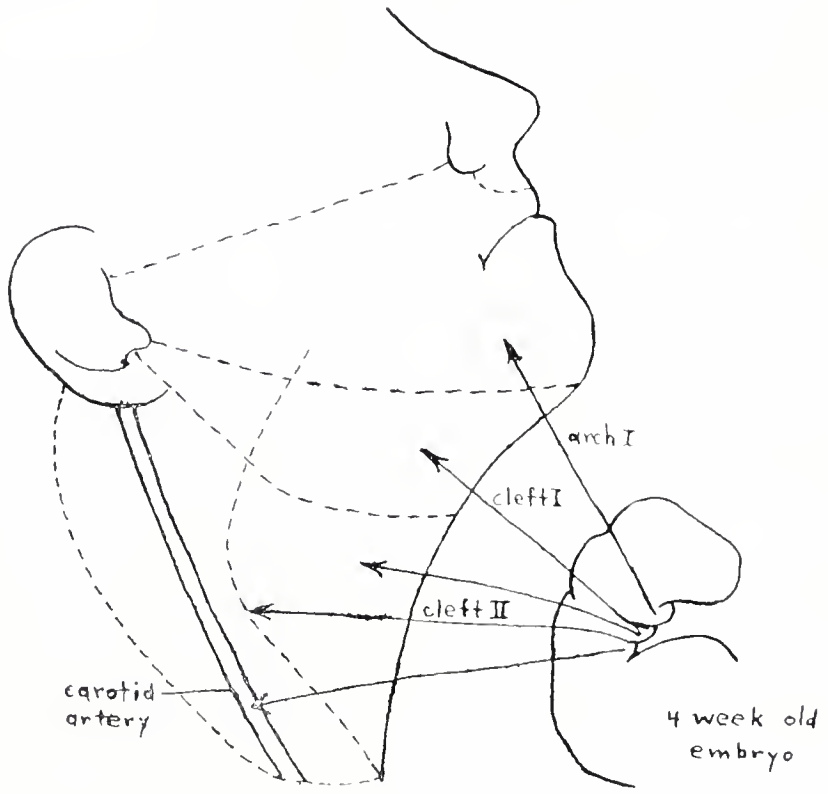
Failure of the thyroid to descend completely results in thyroid rests, the commonest being a pyramidal lobe[3]. Other rests occur in the base of the tongue, along the thyroglossal tract and rarely in the esophagus and in the trachea. Any lump in the midline of the neck should be considered thyroid until proven otherwise.

Any mass suspected of being related to thyroid should be investigated by doing a serum T_4, T_3-resin uptake and thyroid scan. A cold nodule is malignant in 25% and cystic in 20% of cases[1]. Ultrasound scanning can often distinguish cystic from solid lesions. If solid, excision is indicated because of the possibility of malignancy. If cystic, needle aspiration can be performed for diagnosis and for treatment, but it must be remembered that 1-2% of cystic thyroid lesions are malignant[4] and so any aspirate should be sent for cytology as well as for staining and culture.

Parathyroid enlargement is rare and usually is mistaken for a thyroid mass. It can be distinguished by an elevated serum calcium.

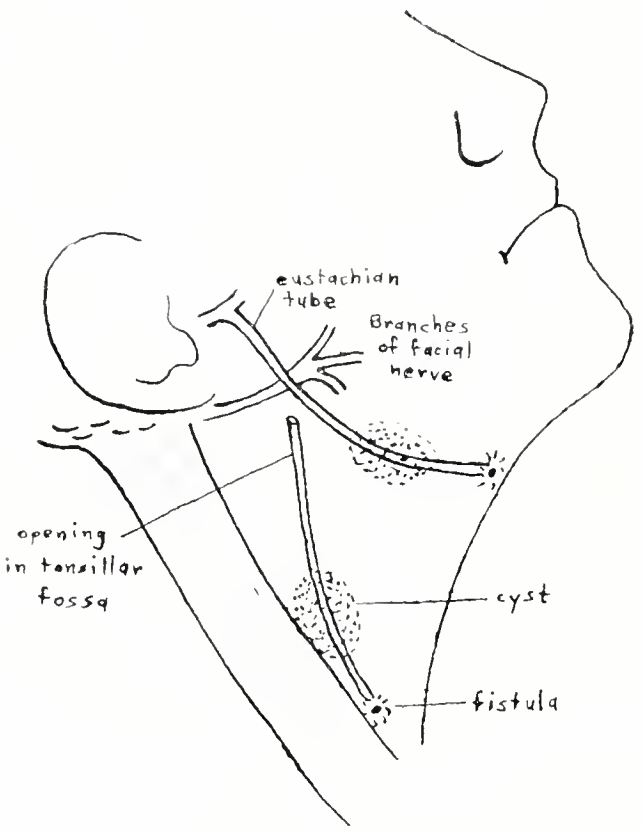
BRANCHIAL LESIONS

The branchial arches and 4 branchial clefts normally fuse to form structures of the lower jaw, larynx, eustachian tubes, blood vessels and other structures of the throat. Failure of normal fusion results in the formation of cysts, sinuses, fistulae or growth alterations.



Formation of the lower face and neck. (Modified from Knute Berger).

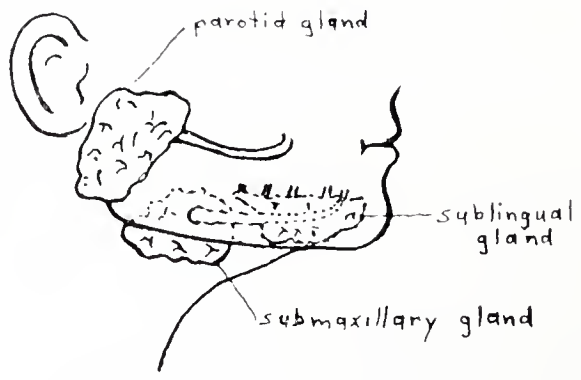
The commonest abnormality is a cyst formed from remnants of the second branchial cleft[5]. This is usually located anterior to the middle or upper 1/3 of the sternocleidomastoid muscle. Any (cystic) lump in this position is most likely a second branchial cleft cyst. A low-lying branchial cleft cyst may at first appear to be a soft thyroid tumor but does not move on swallowing as does the thyroid gland, and both thyroid lobes are often palpably distinct from the cyst.



Abnormalities of Branchial clefts I and II. (Modified from Knute Berger).

SALIVARY GLANDS

There are several important points here. Any lump at the angle of the jaw should be considered as parotid until proven otherwise. Likewise, any lump in the position of the submaxillary gland is considered as such. Even if the common sebaceous cyst occurs at the angle of the jaw it is in the best interests of the patient to consider it as parotid in origin and malignant. A careful excision of a benign cyst does little harm but a partial excision of a carcinoma does little more than seed malignancy in the wound. Another lump at the angle of the jaw, seldom mistaken as parotid, is benign idiopathic hypertrophy of the masseter muscles. This is most often bilateral, giving the patient a sculptured look.



The major salivary glands.

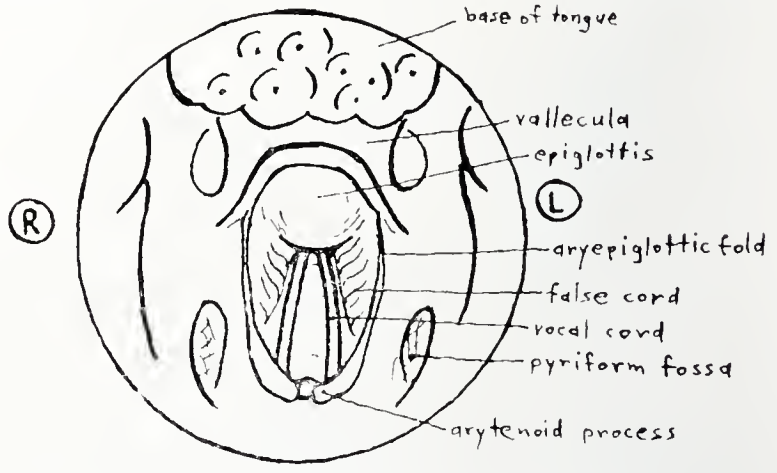
Neoplasms of the salivary glands comprise 5% of head and neck tumors[6], over 70% of these occurring in the parotid gland and over 70% of these being benign[7]. The submaxillary glands and minor salivary glands are involved about equally and the sublingual gland rarely (less than 1%)[8]. These salivary glands have a 50% incidence of malignancy, but overall, malignancy in the salivary glands is fairly uncommon[8]. Nevertheless, any painless swelling without other disease must be considered malignant until proven otherwise. There are no safe indications that a swelling is benign – even a small lump present for several years can be malignant.

A sialogram is performed on the patient only if the history excludes a malignancy; for example, the patient may have submaxillary pain only on eating and may have had a salivary duct stone removed in the past.

LARYNX

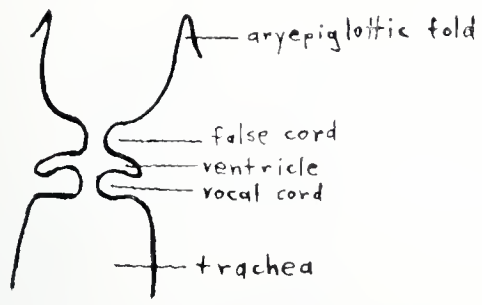
Tumors of the larynx often present with a neck mass which is a metastasis. Three symptoms are common – sore throat, hoarse voice and difficulties swallowing liquids. Any hoarse voice lasting more than two weeks warrants examination to rule out malignancy involving the vocal cords. The classical symptom of aspiration of fluids but not of solids on swallowing indicates a tumor involving a pyriform fossa. One explanation is as follows: solid food pushes the epiglottis down and passes over while liquids pass around the epiglottis and normally splash into the pyriform fossae on passing down. If a pyriform fossa is obliterated by tumor, liquid is forced medially where it can pass between the the arytenoid processes and vocal cords into the trachea. The splashing of liquids into the pyriform fossae is also a possible explanation of the strong association of alcohol and tobacco with tumors of the fossae since they may accumulate in the fossae and act as carcinogens.

Prognosis is usually good for tumors localized to the epiglottis or to the edge of a vocal cord since these have poor lymphatic supply and so metastases are uncommon until the tumor has invaded adjacent tissue[9].



View on indirect laryngoscopy.

Hoarseness of the voice is also commonly caused by vocal cord polyps and nodules. These are treated by excision. Only rarely will radiation be used for several recurrences because of possible complications such as laryngeal edema and resultant respiratory difficulties. Radiation should never be used in growing children to avoid stunting the growth of the larynx.



Coronal section through vocal cords.

No examination of the larynx is complete without visualization. This is afforded quickly and easily by indirect laryngoscopy. It is most important that the approach be systematic. The anatomy must be well known in three dimensions so that the two-dimensional view is easily recognized. A diagram should be drawn in every case to facilitate description. All the structures indicated in the accompanying diagrams should be listed in the order shown, first on the right side and then on the left.

Soft tissue x-rays or xerography (investigational as yet) and tomograms may be done for investigation of laryngeal tumors as well as direct laryngoscopy under general anesthesia.

METASTASES OF THE NECK WITH UNKNOWN PRIMARY

3 to 9% of metastases in the neck present with primary unknown[10]. The primary is either occult, not presenting with symptoms but detectable on further studies, or it is imperceptible being either too small to be seen grossly on any test or being embedded within tissue and causing the tissue to appear abnormal only under the microscope. Since hope for intelligent management of the patient lies in finding the primary there must be complete and frequent searches for it. The investigations eventually prove fruitful in 30 to 40% of cases[10].

In general, primary tumors and their metastases are detected through the use of history, physical, bone scan, skeletal survey, liver scan, serum calcium, serum alkaline phosphatase and peripheral blood smear. Radiographic investigations also performed include chest x-ray, G.I. series, barium enema and I.V.P. Specific tumors may require specific tests.

The histological appearance of biopsy material often gives a clue to the location of the primary. Adenocarcinoma metastases low in the neck usually come from below the clavicle[11]. Thyroid tumor metastases often have a very typical histological appearance.

Table I summarizes the findings of one group[11].

One of the investigations done in searching for the primary is called quadroscopy. This involves direct visualization, under general anesthesia, of four major areas – the naso-, oro- and hypopharynx, the larynx, the esophagus and the bronchial tree.

TABLE I

Metastatic cancer in the neck in 48 patients with primary lesion found later.

Site of Primary Tumor	No. of patients	Time Interval (mo.) 0-12	12-36
Oro- and nasopharynx	11	6	5
Thyroid	9	9	–
Larynx-hypopharynx	4	–	4
Miscellaneous (head and neck)	5	4	1
Lung	10	7	3
G.I. tract	5	3	2
Miscellaneous (below clavicle)	4	3	1
Total	48	32	16

Unfortunately, the prognosis is not good even if the primary lesion is found quickly since the presence of even one metastasis implies that there are probably more.

SOME OTHER COMMON FINDINGS

Lipomas are common on the back of the neck and very uncommon on the front where they can be mistaken for a branchial cleft cyst because of their soft consistency. They may also be mistaken for an enlarged lymph node or a thyroid mass in this location.

Pain usually indicates infection but can also mean nerve invasion or compression by tumor. Pain is often referred to the ear from pathology in the lower jaw or throat.

Abscesses around tooth roots or elsewhere in the neck are common as a result of infection. These may present as painful neck lumps with signs of inflammation and may have fistulae.

TESTS

The important tests have already been mentioned under the appropriate headings; however, biopsy merits special consideration. Unlike the breast where needle biopsy of a suspected malignancy for purpose of diagnosis can be done with little concern of seeding malignant cells in the needle tract, the neck is seldom considered for needle biopsy if malignancy is suspected. Whereas the seeded malignancy in a breast is easily excised along with a wide margin of normal tissue in mastectomy, seeded malignancy in the neck poses a problem since there is little normal tissue to remove. Complete excisional biopsy is the method of choice in obtaining a histological specimen from a neck mass when biopsy must be made for diagnosis; nevertheless, needle biopsy or even partial excisional biopsy is often done if the mass is considered too difficult to excise completely because of size or location. Sometimes radiation is used to shrink the mass to make total excision easier.

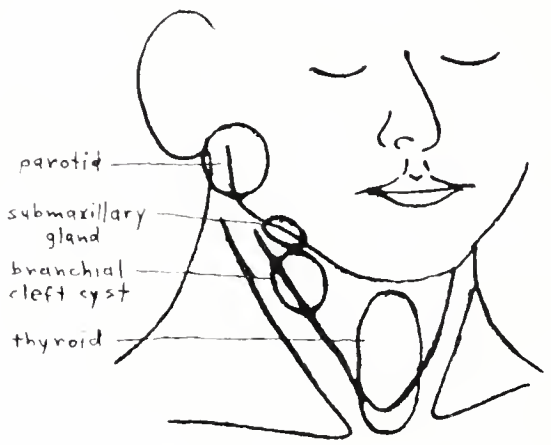
TREATMENT

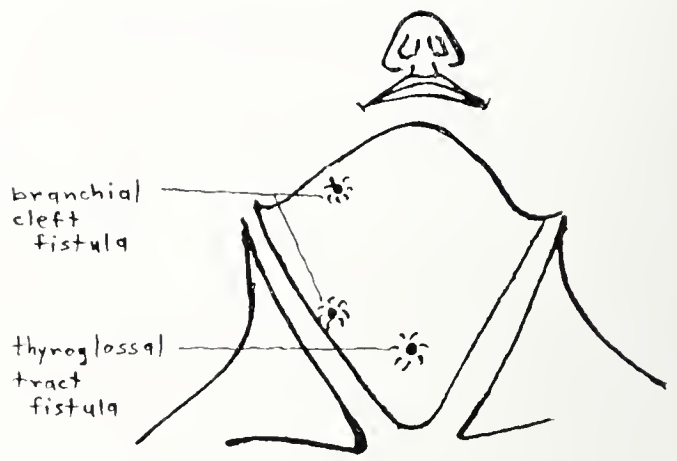
The important thing here is that where malignancy is confirmed by quick section at surgery definitive treatment must not be deferred. Adequate (surgical) treatment must be done at that time to give the patient the best possible prognosis. Other than this, treatment is determined by the pathology whether it be congenital, infectious, malignant or benign.

SUMMARY

There are many different possibilities in considering the differential diagnosis of neck masses, but the list is quickly simplified if only the common lesions are considered.

The following are considered as shown until proven otherwise:





If, in addition, the few important points mentioned are remembered, then gross errors of judgment and treatment can be avoided and the patient given the best possible treatment quickly.

ACKNOWLEDGEMENTS

I owe thanks to several doctors with whom I worked during this elective. Firstly, to my supervisor at The New Mount Sinai Hospital, Dr. I. B. Rosen, I am grateful for the hours spent on rounds, in surgery, in personal discussions and for the helpful comments on this article. A special thanks goes to Dr. P. J. Fitzpatrick at The Princess Margaret Hospital who took a personal interest in showing me malignant lesions. To Dr. M. Miskin at The New Mount Sinai Hospital I extend appreciation for the sessions with ultrasonography, and likewise to all the residents for their informative discussions. Finally, I am thankful for my stay at the Roswell Park Memorial Institute in Buffalo and the cordiality extended there to me.

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Acute Inversion Injuries of the Ankle

J. A. Hibloom, 7T4 &
J. Hamilton-Hall, M.D.

INTRODUCTION

An inversion sprain of the ankle with damage to the lateral ligament is a common injury routinely seen and routinely treated in any emergency department. Unfortunately all too often this injury is perfunctorily seen and improperly treated.

Treatment may be provided by physicians who fail to carry out a good physical examination of the injured joint or who possess inadequate knowledge of the basic anatomy of the area. They treat the soft tissue injury without knowledge of the site of ligamentous injury and therefore without knowledge of the severity of the injury. Since the severity must determine the proper treatment, this lack of knowledge reduces their treatment to guesswork and accordingly it is often inadequate or excessive.

DESCRIPTIVE ANATOMY

The lateral ligament of the ankle is composed of three distinct bands. The anterior band, the anterior talofibular ligament, runs from the anterior border of the lateral malleolus forward and medially to the neck of the talus. The middle band, the calcaneofibular ligament, runs from the tip of the lateral malleolus downwards and slightly backwards to a fullness on the lateral surface of the calcaneus and lies deep to the peroneal tendons (Figure 1). The third band is the posterior talofibular ligament which runs from the bottom of the malleolar fossa medially and slightly backwards to the upper surface of the posterior tubercle of the talus.

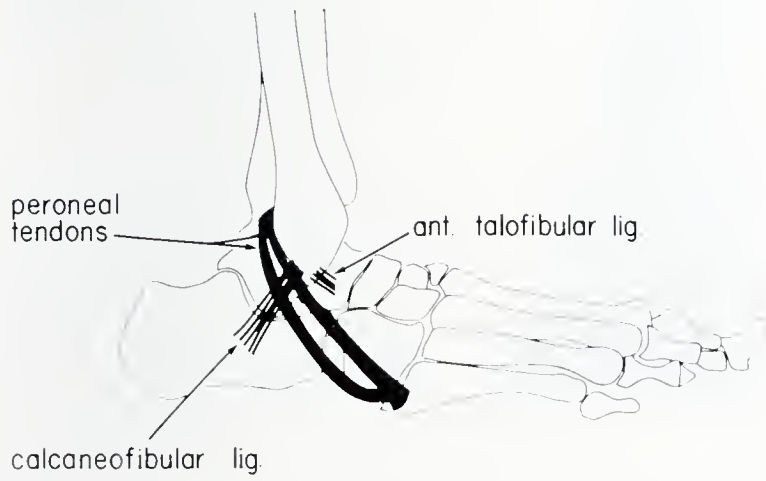


Figure 1 – The significant ligamentous anatomy on the lateral side of the ankle. The calcaneofibular ligament passes deep to the peroneal tendons.

FUNCTIONAL ANATOMY

In simple plantarflexion and dorsiflexion the talus and calcaneus move as one. There is no movement at the subtalar joint. The two bones, moving as a single unit, rotate through an arc described by completing the circle formed by movement of the head of the talus (Figure 2).

Figure 2 – In dorsiflexion and plantarflexion movement is along an arc passing through the head of the talus.

In plantarflexion, the talar attachment of the anterior talofibular ligament moves away from its attachment to the lateral malleolus and this ligament becomes tense while the calcaneofibular ligament slackens (Figure 3A). Thus, plantarflexion is partly limited by the anterior talofibular ligament.

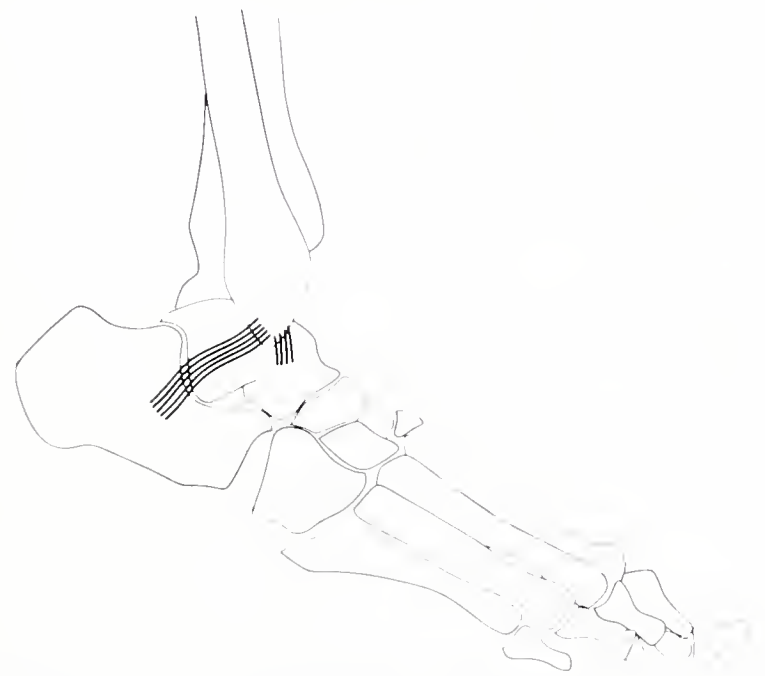
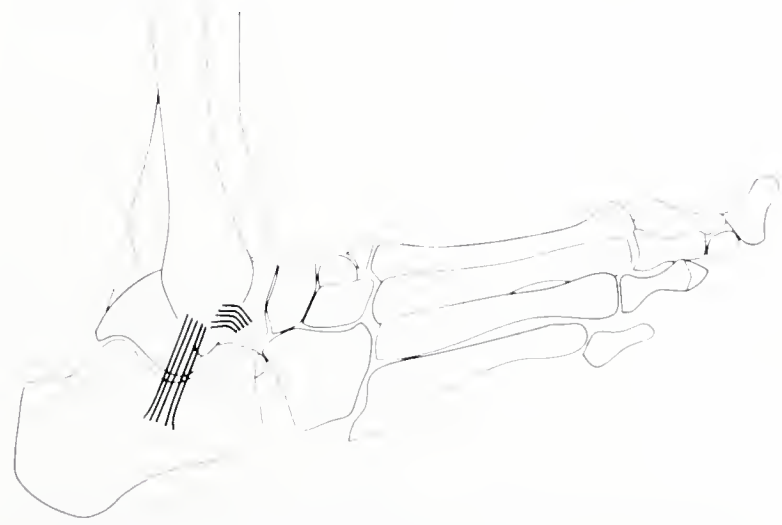


Figure 3 – A. In plantarflexion the anterior talofibular ligament becomes taut while the calcaneofibular ligament becomes slack.



B. In dorsiflexion the calcaneofibular ligament becomes taut as it assumes a more vertical position.

In dorsiflexion, the calcaneofibular ligament becomes more vertically orientated in line with the shaft of the fibula and tension in the ligament increases (Figure 3B). Dorsiflexion is primarily limited by the calcaneofibular ligament.

The movement of inversion takes place at the subtalar joint, the calcaneus rotating beneath the talus around a vertical axis towards the medial side of the talus (Figure 4)[1]. While rotation is taking place the dome-shaped articular surface of the calcaneus produces inversion of the calcaneus beneath the talus and the tension in the calcaneofibular ligament must increase. If inversion is coupled with dorsiflexion the tension in this ligament will be even greater.

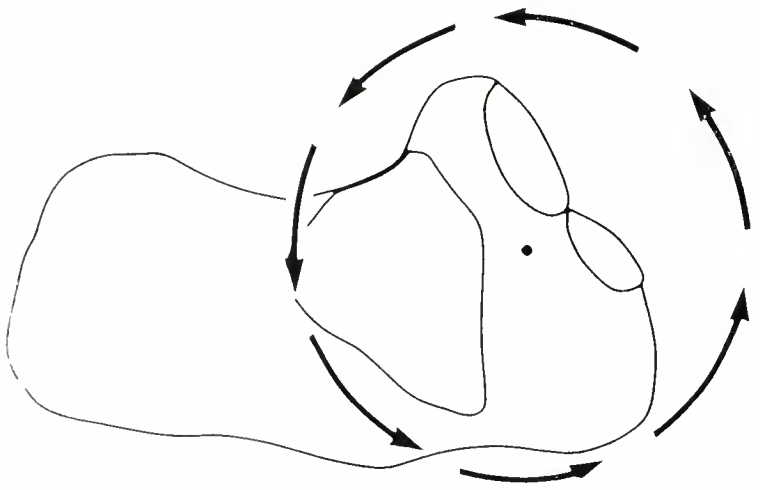


Figure 4 – During rotation of the calcaneus beneath the talus the dome-shaped articular surface of the calcaneus produces inversion of the calcaneus beneath the talus.

PATHOPHYSIOLOGY

The anterior talofibular ligament is the part of the lateral ligament most frequently injured with an inversion strain. Injury to this ligament usually occurs when the ankle is in equinus because it is in the position that the anterior talofibular ligament is maximally stretched. In equinus also, the narrow end of the wedge-shaped talus occupies the ankle mortise making the ankle joint physiologically less stable. When the anterior talofibular ligament is gone the range of plantarflexion increases. The talus rotates medially in the mortise and there is a slight increase in talar tilt relative to the normal side. This degree of increase in talar tilt, however, does not indicate an unstable ankle.

The calcaneofibular ligament is the portion of the lateral ligament which provides the greatest amount of ankle stability. It is torn when the ankle is forced into dorsiflexion and inversion. Stress films taken after such an injury will reveal an increase in talar tilt to a degree indicating ankle instability.

Injuries to the posterior talofibular ligament are rare with inversion injuries of the ankle and will not be discussed in this article.

DIAGNOSIS

The patient presents with pain about the joint after "turning his ankle". Since the mechanism of injury, inversion or eversion, is usually unknown to the patient, the first step in attaining an accurate diagnosis is often a good physical examination of the affected ankle. One must palpate to find the point of maximum tenderness. Is this point over the anterior talofibular ligament, over the calcaneofibular ligament, or is tenderness equally acute over both? Clinical instability may be present, although it is difficult to be sure, and a gap may be palpable between the lateral malleolus and the talus when the ankle is inverted. This gap, if present, will only be palpated early, for swelling soon obliterates it.

Figure 5 – X-ray illustrating talar tilt. The varus strain is applied through the hindfoot.

Plain films of the ankle are always taken to rule out a fracture. If the injury is purely a lateral ligament tear, these films will be negative. Tenderness over the calcaneofibular ligament or any hint of joint instability on physical examination are indications to proceed with *stress* views of both ankles. In stress films the *hindfoot* must be inverted to tilt the talus (Figure 5). If the foot is kept in equinus and held across the metatarsals one tends to invert the forefoot only. The best position for stress films, therefore, is with the

knees bent and the foot in a neutral position while the inversion force is applied through the heel. Stress views are usually taken with the patient fully conscious. However, if the swelling is severe or if the patient is in great pain stress films under general anaesthetia may be required.

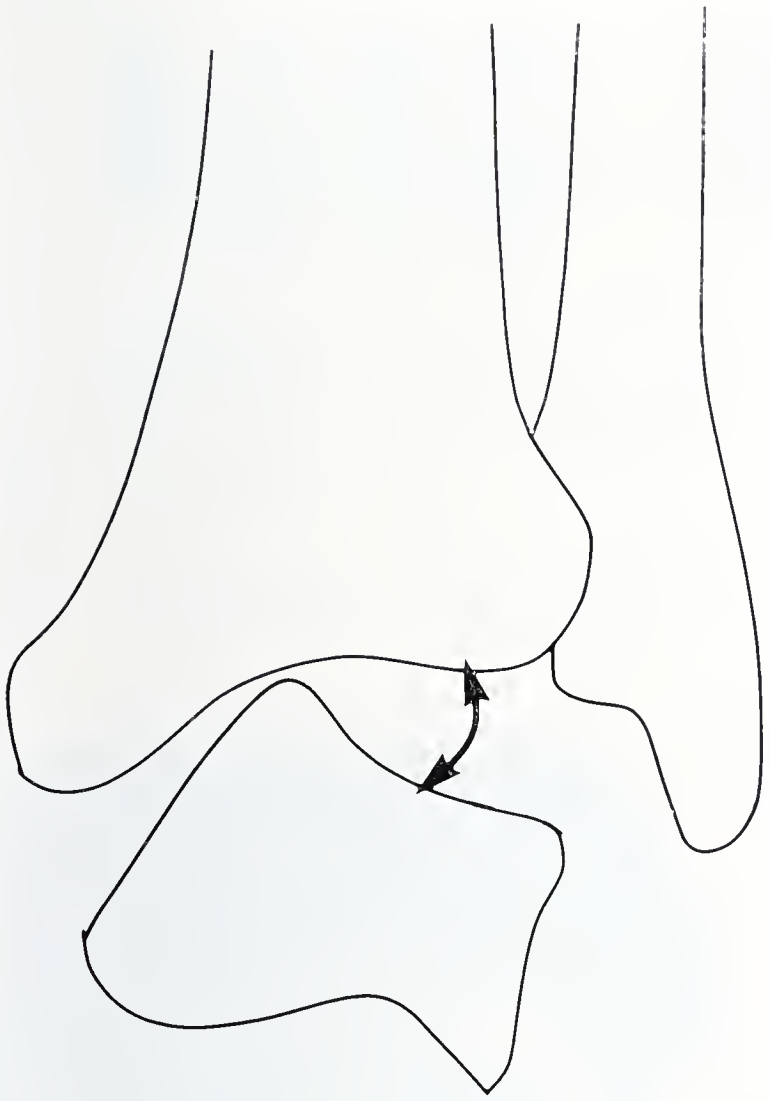


Figure 6 – The normal range of talar tilt is from 0 to 23 degrees. It is always necessary to stress both ankles.

A large amount of normal variation in the degree of talar tilt with varus strain is possible (Figure 6). Rubin and Witten stressed 152 normal ankles and found that in 56% of cases talar tilts ranged from 3° to 23°, while the rest were in the 0°+− range[2]. To determine whether significant talar tilt is present, therefore, the injured ankle must be compared with the uninjured ankle.

TREATMENT

The immediate objects of treatment are to relieve pain and to keep the torn ligaments at the proper length while they heal. The longterm aim is to restore normal ankle movement.

The type of treatment is based upon the severity of the injury. Three common methods are available:

1. observation and symptomatic relief
2. strapping
3. application of a cast

If tenderness is confined to a small area over the anterior talofibular ligament and no ankle instability is suspected, then observation and symptomatic relief are usually the treatments of choice. The patient should be told to restrict activity so as not to overly stress the affected ankle. If a tensor bandage is used it must be understood, at least by the doctor, that the bandage alone will not stabilize the ankle. The tensor may remind the patient that he has suffered an ankle injury and perhaps reduce the initial swelling slightly but it can do little else. If weight bearing is impossible due to pain then crutches may be required. The patient should return to the doctor to have the condition reassessed after two weeks.

In patients who have injured their anterior talofibular ligament and are unable to restrict their activity or in whom the soft tissue injury is felt to be more severe simple observation is insufficient treatment and strapping of the ankle is indicated. For example, if tenderness is present over the calcaneofibular ligament and stress views fail to show significant talar tilt, then the soft tissue injury is probably severe enough to warrant strapping. Strapping, unlike a tensor bandage, does provide ankle stability. In strapping, the adhesive tape is applied with the patient's foot held in a position of neutral dorsiflexion and eversion. Each strip of tape begins on the medial aspect of the ankle, crosses below the foot without tension and extends up the lateral side of the leg where the everting force is applied. The strapping should be maintained for two weeks. If the ankle is still symptomatic after this time a new strapping is applied for another two weeks.

An important part of any initial treatment is to inform the patient about the expected duration of symptoms. Too often patients are told the ankle will be fine "in a day or two", and when pain persists into the fourth or fifth week they become convinced that something has gone wrong with the treatment. Any severe soft tissue injury of the ankle can be expected to produce pain and swelling for at least a month and to a minor degree for some time after that. Follow-up may easily cover ten or twelve weeks from the time of injury. If the patients are told what to anticipate in the beginning, the subsequent management of any prolonged symptoms is far easier.

In the past there has been considerable debate concerning the treatment when findings include significant talar tilt indicating a tear of the calcaneofibular ligament. Some physicians treated the injury by immobilization in plaster while others treated it with surgical repair of the calcaneofibular ligament.

M. A. Freeman[3], in examining 45 patients with injuries to the lateral ligament of the ankle, showed that suture and immobilization were associated with the highest frequency of late disability. Complications included pain, swelling, and limitation of movement.

MacIntosh and Gross[4] performed a follow-up study on 25 patients with significant talar tilt. Their patients were treated only by immobilization in a below knee walking cast for six weeks. Only three patients complained of functional instability which they did not find disabling. The authors concluded that application of a cast alone was good management for injuries to the lateral ligament of the ankle associated with talar tilt.

We agree that tears of the calcaneofibular ligament should be treated by application of a walking cast with the patient's foot in neutral dorsiflexion and eversion for from five to six weeks. A reduction in swelling in the first week after injury may require the application of a new cast.

Treatment of inversion injuries is based upon the the severity of injury. Overtreating tears of the lateral ligament by unnecessary immobilization can result in prolonged rehabilitation and economic loss. Failure to recognize the severity of the injury with subsequent inadequate treatment may result in recurrent inversion injuries to the lateral ligament, persistent pain and stiffness.

SUMMARY

The lateral ligament of the ankle consists of three distinct bands. Only two of these bands, the anterior talofibular and the calcaneofibular are commonly involved in inversion injuries to the ankle. The calcaneofibular ligament is functionally the more important and tears of this ligament can result in ankle instability and significant talar tilt. This injury demands immobilization in plaster. Tears of the anterior talofibular ligament are treated by observation, or if more severe, by adhesive strapping.

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Some Major Aspects of Cardiac Surgery — What is possible Today

George Adam, 7T4

With present day medical training, little emphasis is placed on the complex and broad field of cardiac surgery, but every modern physician must be at least partially aware of this surgical sub-speciality, its existing techniques, orientation of research, and therapeutic benefits. This article understandably will not be able to touch on all these areas or give detailed descriptions of the sub-fields of heart surgery, but it will discuss some major areas.

Some surgeons argue that even after fifty years, heart surgery is still in its infancy, providing only palliative relief to disabled patients with repeated episodes of heart failure, protracted angina or previous myocardial damage. This article will present objective evidence so that the readers may decide for themselves.

A. VALVULAR SURGERY

The most frequently performed valvular operations involve either the mitral or aortic valves.

(i) *Mitral Disease*

In mitral disease both a closed and open heart approach to the valve is possible. Mild to moderate stenosis without demonstrable evidence of calcification within the valve may be treated by a mitral split or commissurotomy, employing the closed approach, which does not entail the additional work involved in cardiopulmonary bypass. Most of the other procedures do involve pump bypass and an open approach. The method gives a much better opportunity to examine the valve by direct visualization. Mitral insufficiency produced only by the dilatation of the valvular annuli may be repaired by annuloplasty which requires only tightening a mattress suture around the valve, once exposure through the left atrium has been accomplished. Both commissurotomy and annuloplasty represent a method of local repair. Most other procedures, including mild to severe regurgitation, severe stenosis or repeated episodes of restenosis following mitral splits involve prosthetic repair.

(ii) *Aortic Disease*

The majority of patients with aortic valvular disease who require surgery will need a prosthetic replacement inserted after total valve excision is performed under cardiopulmonary bypass and coronary artery perfusion. Very rarely are procedures such as valvoplasty done.

(iii) *Prosthetic Valves*

Modern day heart valves can be divided into two types – metallic valve devices, such as the Starr-Edwards valve, and valves of biological material, such as autologous homographs, and valves fashioned from the patient's own fascia lata.

The Starr-Edwards valve is perhaps the most widely used valvular replacement, but there are about fifty other types. The Starr-Edwards is supplied in different sizes which make insertion relatively simple. It is widely available and results in excellent hemodynamic function.

In marked distinction, homografts from cadaver donors are difficult to obtain, and their insertion is complicated and time consuming. Preservation and storage of biological tissue is also fraught with difficulties. These valves are less durable than the metal prosthetics and post-operatively valvular incompetence can develop[1].

Single valve replacement, such as an aortic valve, in most centers entails a risk of 5%. The risk is slightly higher for mitral and multiple valve replacements, in the order of 15%. By contrast, the operative mortality with a closed mitral split is usually less than 1 or 2%.

The late results of these valves are optimistic. Patients receiving the most commonly employed prosthetics have a five year survival of 60 to 65%. Duvoisin and McGoon[2] showed in a six year follow-up of their ball valves for aortic disease that 60% of their patients were still alive after the observation period, the majority with good symptomatic relief. If one considers only those patients with Class II ventricular function (i.e. those with only minimal myocardial changes), the results are even better. Six years after operation 75 to 80% of these patients were alive with a good result in many of them. Baratt-Boyes[3] in a five year evaluation of homografts showed that though 70% were alive after the end of the five years, only about 50% were symptom-free. Some of these patients had even required reoperation.

Another study of six years duration, this one with mitral valve replacement, showed a mortality of only 24% using the Starr-Edwards valve. Some of the survivors were, however, still limited in their activities. The results with newer models of this valve are even more promising.

(iv) *Complications*

The problems in valvular surgery can be divided into two categories – those occurring early after surgery and those arising later.

Heart failure, cardiac arrhythmias, cardiac arrest, excessive blood loss, respiratory or renal failure, embolization, infections, and psychological problems are some of the early complications.

A state of low cardiac output is managed by digitalization; blood is administered for hypovolemia; the

ailing heart is paced through ventricular leads applied during surgery, and inotropic agents such as isoproterenol may be administered. Cardiac monitoring is essential post-operatively because any arrhythmia may occur, such as nodal rhythms secondary to transient inflammation of nodal tissue.

Cardiopulmonary bypass often produces platelet aggregation and this thrombocytopenia is further complicated by oozing from wound and suture sites. In addition the presence of circulating unneutralized heparin can lead to extensive post-operative blood loss. Hemoglobinuria, renal emboli and catecholamine-induced vasoconstriction from hypothermia may lead to acute renal failure. It is therefore essential to follow each patient's BUN, serum creatinine and renal output in the immediate post-operative course.

Bacterial endocarditis is a very serious early as well as late complication of valvular surgery. The fibrinoid necrosis generated can lead to loosening of suture lines and valvular incompetence. Other long term, late problems include thrombotic episodes, necessitating lifelong anticoagulants, restenosis and chronic anemia from valve induced hemolysis.

(v) *Selection*

It should become obvious that with the complications and morbidity involved in valvular surgery, everyone with valvular disease should not be considered for surgical correction. Who then is a suitable candidate for surgical intervention? In general, surgery is advised before irreversible myocardial damage has occurred. In aortic regurgitation, significant elevation of the end-diastolic pressure of the left ventricle has been the best criterion for surgical replacement. When the symptoms of heart failure and arrhythmias set in, surgical reversal of the underlying pathology may already be too late. Debilitating angina, progressively more frequent attacks of syncope and a gradient of 50 mm. Hg. across the valve have been shown to be important guidelines for considering surgery in aortic stenosis.

Patients with significant limitations to daily activities, who are refractory to medical management, should be considered for valvular replacement in mitral disease. Those patients with moderate stenosis and without evidence of calcification in the valve should be considered earlier for surgery, since they respond so well to simple commissurotomy. Radiological evidence or catheterization data indicating pulmonary hypertension necessitates surgical intervention in mitral disease.

B. MYOCARDIAL REVASCULARIZATION

(i) *Coronary Artery Disease*

Coronary atherosclerosis has assumed almost epidemic proportions in the Western Hemisphere. In 1970 alone, there were almost 600,000 myocardial infarcts in the United States. At least 70% of these people died within a matter of hours or days, and of the survivors half were dead in five years. Not only were many of these survivors limited physically and psychologically but often they were unable to return to old jobs because of employer's prejudices[4].

A much more shocking statistic implicates coronary artery disease in the deaths of an even larger segment of the younger population. Cardiac surgery's role in this problem must be to open new lines of treatment for these younger patients, whether suffering from acute myocardial ischemia or chronic myocardial disease.

(ii) *Selection*

Successful revascularization depends on accurate angiographic demonstration of arterial occlusion and estimations of ventricular function. Surgery is usually not indicated in the early or debilitated patient. Patients responding well to medical management are also not considered for surgery. Patients with extensive myocardial dysfunction are unacceptable for surgery due to high operative mortality and unimpressive improvements in symptomatology. These are the patients with Grade IV ventricular function by angiographic estimations. Demonstration of an 80 to 90% block in a major vessel on angiography usually warrants surgical intervention. Progressive cardiomegaly or increasing left ventricular end-diastolic volume with accompanying low ejection fractions may also be used as criteria.

(iii) *Operative Procedures*

The two major methods for revascularization are by the Vineberg implant and the aorto-coronary bypass.

The Vineberg procedure entails implantation of the internal mammary artery into the ischemic myocardium, thus providing a source of indirect perfusion. The internal mammary implant does not involve cardiopulmonary bypass.

The aorto-coronary bypass involves dissecting and removing a predetermined length of saphenous vein from the patient's left thigh, reversing the direction to establish flow that will not be impeded by the venous valves, then establishing an anastomosis, first at the distal end of the coronary obstruction and then at the aorta. Saphenous vein grafting requires not only the pump but also electrical fibrillation of the heart, hypothermic anoxic arrest and ventricular venting to steady and dry the operative field. Grafting is then performed under magnification with perfect intima-to-intima approximation.

In a study of 150 patients who underwent surgery at Toronto General Hospital, of the 213 vessels grafted, 200 were either to the right coronary artery (proximal to its bifurcation into the posterior descending artery and A-V node artery, distal to the acute marginal branch) or the anterior descending artery (distal to the septal take-off)[5].

Both these procedures may be combined at the time of operation to provide maximum perfusion for the ailing heart. Other revascularization procedures such as early resection of acute infarcts, endarterectomy and thrombectomy at the time of infarction have been utilized but with only limited success.

(iv) *Results*

The single implantation of a mammary artery has been shown to relieve, or improve symptoms in over 80% of patients after operation. Saphenous vein grafting may be equally as promising. In patients with Grade I to III ventricular function the post-operative re-evaluations show that in the majority there was considerable relief after even two years. Those patients with Grade IV left ventricular function did much worse after surgery, with a high incidence of post-operative complications[6].

The operative mortality of a Vineberg implant is under 4% as compared to that of the aorto-coronary bypass which is in the order of 5%.

(v) *Summary*

It seems logical to ask why one procedure may be preferred over the other if, in selected groups, the results are identical. The differentiation is made on a time basis. The formation of collateral channels to the parent vessels in a Vineberg implant is slow, in comparison to the immediate establishment of new blood flow with a vein graft. Furthermore, the immediate results may be very important in certain clinical conditions such as pre-infarction angina and in acute infarction.

The value of revascularization however, can only be assessed after further investigation aimed at demonstrating graft patency.

The present state of knowledge concerning the natural history of coronary atherosclerosis must be improved if patients are to further benefit from surgical therapy. Through angiographic examination in an increasingly younger population criteria will be developed for the optimum times for operative intervention and for the identification of asymptomatic patients with moderate to advanced coronary artery disease, who may require prophylactic surgery.

C. EMERGENCY CARDIAC SURGERY

(i) *Pulmonary Embolectomy*

Surgical intervention is indicated in pulmonary embolism when anticoagulants fail, or if Heparin is contra-indicated. If the problem is multiple recurrent emboli, septic emboli or massive embolization, surgical assistance should be sought.

For these unfortunate patients, two alternatives are possible – (1) vena caval interruption, or (2) pulmonary embolectomy with caval interruption.

In a review from Ohio State Medical School on the use of surgical therapy for pulmonary emboli, inferior vena cava interruption was accompanied with a 17% mortality. This figure was twice as high for pulmonary embolectomy, the same mortality rate as in a surgically untreated control group. In some centers the mortality rate for embolectomy was as high as 80 to 85%.

With such a high toll of lives it seems obvious that guidelines for selection of patients suitable for embolectomy must be established. Williams *et al*[7] feel that in patients with – (1) angiographic evidence of a large block in the pulmonary artery (P.A.), (2) accompanied by an acute elevation of P.A. pressure above 25 mm Hg, or by hypotension refractory to vasopressor therapy, embolectomy and caval interruption, by clips or ligation should be attempted.

With lesions in the main P.A. the best approach is through a sternotomy. The P.A. is exposed, pulmonary bypass achieved and the embolus is removed with a Fogarty catheter, which is pushed past the lesion, inflated, then withdrawn. The artery is then irrigated with saline and both lungs are compressed manually to remove residual emboli.

With emboli in either the right or left pulmonary artery an anterior thoracotomy on the affected side is performed. The Fogarty catheter is similarly passed into the distally clamped artery.

(ii) *Emergency Valvular Surgery*

The abrupt onset of cardiac symptoms or the sudden worsening of previous symptoms, with the appearance of a loud apical systolic murmur should alert one to the possible diagnosis of ruptured cordae tendinae in the mitral valve. The cause may be mitral valvulitis complicated by necrosis, an inferior myocardial infarct, or papillary muscle infarct.

The ruptured cordae may be repaired with or without annuloplasty or the entire valve may be excised and replaced by a prosthetic. The best long term results seem to be with the latter procedure.

(iii) *Emergency Revascularization*

Saphenous vein grafting may produce immediate improvements in coronary flow. This is especially valuable in conditions such as pre-infarction angina where myocardial damage can be prevented and in acute infarction where the extent of myocardial damage can be limited. Emergency grafting may also benefit patients with cardiogenic shock following infarction, who are unresponsive to medical management.

Pre-infarction angina is usually diagnosable by a triad of symptoms including a history of sudden abrupt pain, ST segment depression and the angiographic demonstration of stenosis in a coronary artery of greater than 85% (there is usually only a localized obstruction with good distal patency) Flemma *et al*[8]

Cont. on inside Back Cover

Flatfeet: Who are our Arch Enemies?

M. G. Martin, B.A.Sc., 7T5

INTRODUCTION

Although not officially recognized as an occupational disease, flatfeet are very common among soldiers, policemen and nurses[1]. In 1947, the Canadian Armed Forces[2] demonstrated that almost one quarter of their personnel were affected to some degree by this condition thus becoming one of the first groups to actually measure the size of the problem (in feet!).

Despite the frequency of the condition, and the resulting disability, practitioners have tended to neglect this practical and interesting field with the result that the public has become accustomed to seeking assistance from podiatrists, chiropodists, and the salesmen of shoes and appliances. Recently, however, there has been a renewed interest in this field and it is hoped that this article will serve as a review of some of the commoner causes of flatfoot.

It is important to note that the concept of flattened arches has probably done more to confuse the diagnosis and treatment of static disorders of the foot than any other factor. An arch may or may not be present and this often bears little relation to body size or shape, or to foot function. Many individuals present with low arches which are perfectly adequate. It is only when function is impaired and symptoms develop that a clinical problem arises.

Before reviewing the present concepts of pes planus, or flatfoot, it might be interesting to read the following description of a patient who presented in 1888[3].

"The arch of the foot is lowered; or completely broken down, so that the entire sole rests upon the floor; on the inside of the foot the slight normal outward curve from the heel to the head of the first metatarsal is replaced by a bulging inwards, most prominent below and in front of the internal malleolus. The foot seems broader than usual, and the internal malleolus is abnormally prominent; when the patient stands, the entire foot seems displaced outwards on the leg, this being especially marked when looking at it from behind; the tissues on the inside of the arch and ankle seem thickened and congested; prominent veins and increased moisture of the foot are often noticed . . ."

NORMAL STRUCTURE OF THE FOOT

In order to examine the foot, one must bear in mind its normal structure and function. Although classically three arches are described in the normal foot, the most prominent is the medial longitudinal arch formed by the calcaneus, the cuneiforms, and the heads of the three medial metatarsals. These arches are normally maintained by the bones and ligaments, which offer static or structural stability to the foot, and by the intrinsic and extrinsic musculature which provides a resilient spring for propulsion during walking.

In the normal foot, weightbearing is shared equally by the forefoot and the hindfoot. This normal distribution is changed when the heel is raised by footwear so that additional strain is transferred to the forefoot. All five metatarsal heads participate to some degree in the weightbearing, however, the distribution of the weight varies with the shape of foot, the type of footwear, and whether the foot is stationary or in motion.

The long axis of the foot is normally pointed at about 15° outward. Since both the ankle mortise and the knee joint permit flexion and extension only, this outward rotation normally occurs at the femur. This means that the patella can be used as an indication of limb rotation and a line dropped from the middle of the patella should fall between the first and second toes. Normally this angle decreases when the patient is walking.

EXAMINATION OF THE FOOT

Examination of the foot should begin with observation of the gait for evidence of a limp, a shortened tendo-achilles, or any postural changes which may have resulted from or contributed to changes in the the normal architecture of the foot.

The type of footwear should be noted and inspected for evidence of abnormal wearing. Normally the lateral side of the sole and heel wear first. The two feet should be compared for any evidence of swelling, atrophy, or deformity; and the individual feet should be inspected for any calluses or bursal reactions which might indicate the pattern of weightbearing. The presence or absence of an arch and the posture of the foot should be noted, first with no weight on the foot and then with the foot weightbearing.

When palpating the foot, one should search for any evidence of swelling, tenderness, or rigidity. One should also note any nodules or irregularities which may occur subcutaneously or along tendons. The active and passive ranges of motion of all joints of the foot should be determined and recorded. In general, a supple, mobile foot is rarely painful.

FLATFEET IN CHILDREN

Static disorders of the ankle and foot are extremely common in children and are frequently a cause of alarm for parents. The majority of these disorders are symptomless and appear to improve spontaneously. There are, however, a few relatively uncommon causes of flatfoot which can become severely disabling and their early diagnosis and treatment is mandatory.

Almost all children have flatfeet for the first year or so after they begin to stand. This is generally a

symptomless condition but the parents may notice the child toeing in, toeing out, or wearing down the insides of his heels. All children seem to have a generalized hypermobility of their joints due to an incompletely developed skeleton and to weak muscles and ligaments. This permits some distortion of the foot when it is weightbearing. Also, the presence of an extra pad of fat tends to fill in the normal arch making it appear flattened. This form of flatfoot is commonly referred to as "flexible flatfoot" since the foot characteristically appears flat only when the child is standing. Generally no treatment is recommended for children under three because the condition tends to improve spontaneously. For cases persisting beyond this time, treatment is aimed at preventing further stretching of the ligaments and at strengthening the intrinsic muscles of the foot. This may require the use of sturdy, properly fitting shoes with arch supports. In severe cases, or in those complicated by muscle weakness as in polio, operative techniques may be necessary.

Despite the frequency of this rather benign condition, it is very important to examine the foot thoroughly in order to rule out the few uncommon but disabling forms of flatfoot. One of these disorders, known as "vertical talus", or more fancifully as "diving duck" astragalus flatfoot is due to a subluxation of the talo-calcaneal joint. Radiographs usually show the talus to be displaced plantarward and medially so as to be almost vertical. The defect produces a "boat-shaped" convex sole and may be associated with a shortening of the dorsiflexors of the foot. As the foot develops, adaptive changes occur in the tarsal bones which make treatment ineffective unless begun in the first months of life. The condition may be associated with spina bifida or arthrogryposis.

FLATFEET IN ADULTS

Despite an increased interest in this problem and the recognition of predisposing conditions such as obesity and prolonged bed rest, flatfeet remain a major source of discomfort and disability to some adults. In the Canadian Armed Forces survey previously referred to, 22.5% of the men surveyed were affected to some degree. In this survey, three classes of flatfoot were defined: i) a spastic type which affected 2% of men, ii) a hypermobile type which affected 6%, and iii) "all other types". This latter group included a large number of less common types of flatfoot which will not be discussed here.

i) *Peroneal Spastic Flatfoot (Tarsal Coalition)*

In 1905, Sir Robert Jones first described a very painful type of flatfoot characterized by rigidity of the foot accompanied by spasm of the peroneal muscles. The underlying condition was consequently shown to be an abnormal coalition between two or more tarsal bones. While some of the coalitions are secondary to traumatic or inflammatory conditions of the foot, the majority of them are thought to have been present from birth. These coalitions occur most frequently between the os calcis and the navicular bones, however, talo-calcaneo and calcaneo-cuboid bridges are also common.

Although the majority of the coalitions are present from birth, they are commonly undetected until adolescence when ossification is completed and secondary changes in the foot have occurred. The typical patient is a young male who presents with a rigid painful foot and spasm of the peroneal muscles following a period of prolonged use. The foot looks flat, and is held in a position of valgus and eversion. The patient often walks with a slow shuffling gait. Since the adhesions may be cartilaginous or fibrous, an x-ray does not always demonstrate any abnormality. A history of pain following prolonged use may date back to early adolescence.

The mechanism of the spasm is uncertain but may be as follows: Because of the coalitions, the subtalar, talonavicular and calcaneocuboid joints must act as a unit. This places extra strain on the remaining mobile joints of the foot which leads to the early development of secondary degenerative arthritis of these joints. This arthritis, combined with the increased strain placed on the ligaments of these joints, causes a local irritation which somehow triggers the spasm of the peroneal muscles.

Treatment of this condition is operative and usually involves triple arthrodesis.

ii) *Hypermobile Flatfoot*

This second form of flatfoot is really a form of chronic foot strain and is characterized by a longitudinal arch which flattens during weightbearing. While this is often asymptomatic, especially in childhood, it may eventually present with pain along the medial border of the foot radiating to the posterior calf muscles. The usual history is that the foot became "hot" and uncomfortable after long periods of standing or walking. Eventually, walking became painful and may have resulted in a clumsy gait. The condition most often becomes symptomatic when the muscular support of the foot fails due to excessive strain (a weight gain or overuse) or due to atrophy (following a prolonged bedrest or in the course of a chronic illness). Occasionally the cause may be attributed to osseous or ligamentous derangements following trauma or disease. There is no good correlation between footwear and the development of chronic foot strain in a normal person although improper footwear may aggravate the symptomatology in a person with existing flatfoot.

On examination, the foot is tender and painful at extremes of motion. One should note the contour and

alignment of the knees and tibia since either external tibial torsion or genu valgum may contribute to the deformity of the foot. X-ray findings are generally unremarkable in this condition.

Symptomatic relief may be obtained with rest, heat, massage, or contrast baths of hot and cold water. Since weakness of the intrinsic muscles is often a contributing factor, arch supports and exercises to increase the tone of these muscles should be encouraged. When appropriate, weight loss should also be encouraged.

SUMMARY

Flatfoot is a common disorder of practical importance to the physician not only because of the disability it may cause, but also because the lay conception of "fallen arches" causes many otherwise asymptomatic individuals to seek assistance. While one must always consider other causes, such as an arthritis or a march fracture, in the differential diagnosis of a painful foot; flatfoot may often be readily diagnosed and treated.

Although some degree of flatfoot is normal in most infants, care should be taken to exclude the few more serious forms of flatfoot which, if not corrected early can lead to great disability later on.

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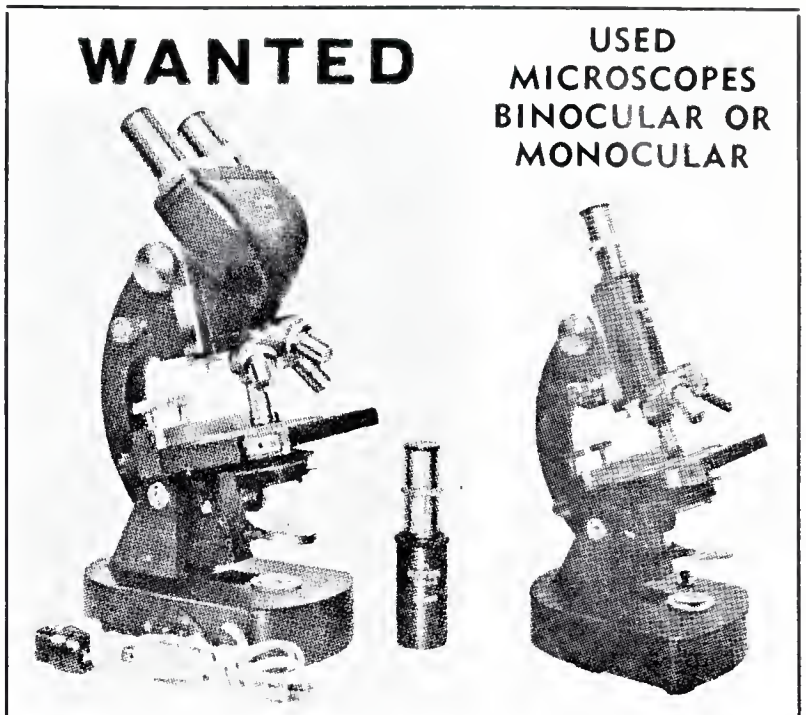
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have shown in 80 patients that the majority of patients who underwent operation for preinfarction angina had both good early and late results. These figures are encouraging when compared to the high mortality involved in myocardial infarction. The mortality rate from the surgery was in the order of 5%.

Bypass procedures in patients after infarction, though theoretically sound, have proven to be of uncertain benefit and hazardous. The survival rates are low and the overall results do not give cause for optimism.

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